Before the

FEDERAL COMMUNICATIONS COMMISSION

Washington, DC 20554

In the Matter of	)	
	)	
Revision of Part 15 of the Commission's Rules	)	
Regarding Ultra-Wideband Transmission	)	
Systems	)	ET Docket 98-153
	)	
To: The Commission	)	

COMMENTS OF ROCKWELL COLLINS, INC.

Rockwell Collins, Inc. ("Rockwell Collins") a subsidiary of Rockwell International Corporation, pursuant to Section 1.415 of the Federal Communications Commission's ("Commission's") rules, hereby files electronic comments in the above referenced proceeding which seeks to investigate and possibly permit the operation of ultra-wideband ("UWB") radio systems on an unlicensed basis under Part 15 of the Commission's rules.

INTRODUCTION

Rockwell Collins is a major manufacturer and integrator of avionics and Global Positioning System (GPS) equipment and systems for civilian and military markets. In addition to GPS equipment, Rockwell Collins manufactures a complete series of civilian and military aeronautical radio communications, navigation, and surveillance equipment that use signals in the Part 15 restricted bands.[1] These include Instrument Landing System (ILS) receivers, L-Band Distance Measuring Equipment (DME), Traffic Alert and Collision Avoidance units, Air Traffic Control Radar Transponders, L-Band aeronautical mobile satellite communications equipment, C-Band Radio Altimeters, Microwave Landing System (MLS) receivers and weather radars.

[1] See 47 CFR Section 15.205

Rockwell Collins has long been engaged in assisting government and industry in developing solutions to external interference within the GPS frequencies. Rockwell Collins was an active participant in the Commission's Above 1 GHz Negotiated Rule Making Committee ("Big-LEO" Mobile Satellite Service) and in the RTCA efforts, through Special Committee 159, to create and deliver RTCA/DO-235.[2] Today, Rockwell Collins is engaged in the development of RTCA and ICAO system and receiver standards for aeronautical Global Navigation Satellite System (GNSS) use. Rockwell Collins is also an active participant in technical studies and policy formulation on GPS interference issues in the US delegation to Working Party 8D of the International Telecommunications Union – Radiocommunications (ITU-R) Sector.

DISCUSSION

Rockwell Collins recognizes that UWB devices may offer significant benefits for public safety, businesses and consumers and understands the Commission's desire to move forward the regulatory process enabling UWB technology deployment. In fact, Rockwell Collins is studying UWB technology for possible use in future avionics communications, navigation, or surveillance applications with appropriate electromagnetic compatibility measures. Rockwell Collins supports and encourages the Commission's stated commitment "to ensuring that safety services, such as GPS are protected against harmful interference."[3] To ensure this protection, Rockwell Collins strongly believes that adequate testing and analysis of UWB devices and their potential for interfering with GPS signals and other safety service signals operating in the restricted bands (47 CFR §15.205) must be done prior to any final rulemaking. To that end, Rockwell Collins offers the following comments in the above proceeding.

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[2] RTCA SC-159, "Assessment of Radio Frequency Interference Relevant to the GNSS," Doc. No. RTCA/DO-235, Jan. 27, 1997, RTCA, Inc., Washington, DC

[3] See Separate Statement of Chairman William E. Kennard, FCC 00-29, ET-Docket No. 98-153, Released July 14, 2000.

1. **The October 30 deadline[4] for submitting test results does not provide enough time for sufficiently comprehensive testing and should be extended at least 120 days.**

The Commission recognized the complexity of the interaction between UWB and radio communication systems when it acknowledged that further testing is needed before the Commission could authorize UWB transmission systems to operate in the protected services bands.[5] Further, the Commission has stated that: "ample opportunity to complete testing and analyses of testing data will be allowed before adopting any final rules in this proceeding."[6] Rockwell Collins agrees that the technical questions raised in the above proceeding are complex. Because of the complexity of the questions raised, most testing groups will be unable to meet the October 30, 2000 deadline for submitting test data.

In late 1999 the RTCA was tasked by the Department of Transportation (DoT) to investigate the radio frequency interference (RFI) environment in the vicinity of the new GPS L5 frequency (1176.45 ± 12 MHz). RTCA was to determine appropriate receiver susceptibility criteria and related RFI unwanted emission limits for the use with the new civil signal. In July, the DoT requested the study be enlarged to explicitly treat UWB RFI effects and operational scenarios (including non-aviation ones) for the GPS L1 frequency (1575.42 ± 12 MHz) as well as L5. Rockwell Collins has been actively engaged in this effort. The RTCA study group first interim report to DoT[7] finds that the preliminary results from the DoT-sponsored UWB RFI tests at Stanford University "indicate a potentially significant RFI effect for several UWB waveforms at present Part 15 limits."[8]

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[4] Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems, FCC 00-163, Notice of Proposed Rule Making, (released May 11, 2000), at Para. 31

[5] Id. at Para. 1.

[6] Id. at Para. 1

[7] RTCA SC-159, "Ultra-Wideband Technology Radio Frequency Interference Effects to GPS and Interference Scenario Development, First Interim Report to Department of Transportation," 12 September 2000, http://www.rtca.org/comm/pmcSC159report.PDF

[8] Id. page 31.

These results are just for one receiver capable of precision approach use. Rockwell Collins believes the tests need to be repeated on more receivers including different application types, before trends can be thoroughly validated and RFI impact models developed. The report also finds that "because of potential differences in GPS L5 receiver operation compared to L1, there is also a real need to investigate the UWB RFI effects on L5 receivers."[9] No L5 receiver hardware models presently exist for use in RFI tests and no development effort is known to be underway. Constructing and testing a representative one will require at least 120 days if not more.

As for the current testing situation, Rockwell Collins is aware of 3 projects underway to test UWB RFI effects to GPS receivers: 1. Stanford Univ./DoT; 2. NTIA; and 3. Univ. of TX Applied Research Labs/Time Domain. Rockwell Collins is also aware of one project (NTIA/NIST) to characterize UWB emission measurement methods and determine RFI effects on some key government receiver systems other than GPS. It is Rockwell Collin's understanding that the Stanford University test effort will likely be complete on one aviation-type GPS receiver by the October 30, deadline. However, the land application receiver tests are not likely to be finished until late December, 2000. The NTIA GPS testing start has been delayed in part due to legislative funding issues. Funding and contractual issues have delayed the start of an important additional effort to duplicate Stanford's results on a second aviation precision approach GPS receiver. Even if the University of Texas Applied Research Labs test efforts are completed by October 30, 2000, the data they propose to output are raw receiver measurement streams that will take significant additional time to post-process to a form similar to that used by Stanford and NTIA.

It is clear there is insufficient time for most if not all testing to be completed by the October 30, 2000 deadline.

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[9] Id.

2. The frequency below which UWB transmission systems should have special restrictions should be raised to 5.15 GHz from the proposed 2 GHz.[10]

The Commission requested comments on what the frequency limit should be below which UWB operations need to be restricted[11] and also what form those restrictions should take.[12] Rockwell Collins believes the 2 GHz limit frequency discussed in the NPRM should be raised to 5.15 GHz, especially for outdoor UWB communication and outward-directed radar applications. This change will accommodate two flight-critical approach navigation systems, Radio Altimeters operating 4.2 to4.4 GHz, and MLS receivers operating in the 5.03 to 5.09 GHz band. Both of these systems have relatively wide RF front-end bandwidths, use modestly directive antennas pointed toward the ground to acquire their received signals, and have rather high sensitivity. Because these systems are used in Category III approaches (essentially zero visibility), they require extremely low probability of disruption ($< 10^{-7}$ per operation). Allowing intentional UWB transmission in those bands would entail a very significant regulatory burden to assure present levels of safety are maintained.

As for what form should the UWB restrictions take, Rockwell Collins currently believes that for outdoor UWB devices (e.g., communications and radar devices other that Ground Penetrating Radars and wall imaging devices) at least some sort of notch filtering should be required in the critical bands. Highpass filters rejecting emissions below 5.15 GHz would be an acceptable alternative. Other restrictions on emission levels may also be necessary pending the outcome of the current RFI tests.

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[10] UWB NPRM *op. cit.* at Para. 29.
[11] Id.
[12] Id. at Para. 30.

3. The cumulative impact of multiple UWB transmitters needs to be the subject of an extensive and thorough investigation with both analytical and experimental aspects.

One of the potentially most troublesome and yet least understood aspects of UWB operation[13] is that of the cumulative (or aggregate) RFI impact from multiple UWB transmitters near a given victim receiver location. If UWB transmitters were to proliferate into all sorts of portable, mobile, and fixed applications, there is the very real possibility that several tens of devices could occupy a space roughly 30 feet in diameter. If, for example, that circular space were under a Category I aircraft approach at the critical point, all UWB emitters would have a path loss within 0.1 dB of one another to a GPS receiver in an aircraft 100 feet above them (the Cat. I approach scenario of RTCA/DO-235, Appendix. A). This is important because the Commission contends that only the nearest transmitter is of concern, not the cumulative impact of multiple transmitters.[14]

Even if the emissions added incoherently in average power, the RFI effect would considerably exceed that of the single "Big-LEO" Mobile Satellite Service terminal in the DO-235 Category I scenario. Current aggregate RFI tests to GPS planned by NTIA and University of Texas include only a small number of UWBs and are superficial. These tests are unlikely to give a very good basis for such an important aspect of the rulemaking, namely the proper allowance for cumulative effect. A thorough and extensive theoretical and experimental investigation must be conducted into the RFI effects of cumulative UWB emissions. A proper investigation could be expected to take between 6 months to 1 year.

Summary

Rockwell Collins, therefore, is concerned that the Commission will have very limited data upon which to render an informed decision if it adheres to the schedule outlined in the NPRM. It is

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[13] See for example T. W. Barrett, "History of Ultra-Wideband Radar and Communications: Pioneers and Innovators," Progress in Electromagnetics Symposium 2000, July, 2000, Cambridge, MA, pg. 19.

essential that the impact of the UWB emissions on critical infrastructures such as telecommunication and electric power networks that rely on GPS precision timing, and on aviation and maritime safety-of-life applications, be fully understood before allowing unrestricted or even limited use of UWB devices. Rockwell Collins believes that additional time should be granted for completion of testing that is underway so that interested parties can properly respond to the NPRM and the Commission can make an informed and reasoned decision regarding the use of UWB devices.

It is clear there is insufficient time for most if not all testing to be completed by the October 30, 2000 deadline. For the foregoing reasons, Rockwell Collins requests that the Commission extend the filing deadline for testing and analysis data for 120 days until February 27, 2001. Please direct any questions to Joseph Cramer at 703-516-8213.

Respectfully submitted,

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[14] UWB NPRM *op. cit.* at Para. 47.